



# Forensic Guide to the Investigation, Recovery And Analysis of Human Skeletal Remains

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# Introduction

This *Forensic Guide to the Investigation, Recovery and Analysis of Human Skeletal Remains* is published within the context of the Project “**Promoting Justice for the Extrajudicial Killings and Enforced Disappearances in Colombia, Peru and Guatemala**” (EuropeAid/155232/DH/ACT/Multi), conducted by the International Commission of Jurists (ICJ), in partnership with the Asociación Red de Defensores y Defensoras de Derechos Humanos (Network of Human Rights Advocates Association) (Colombia) and the Equipo Argentino de Antropología Forense (EAAF), to promote accountability and reparation in cases of extrajudicial killings and enforced disappearances. For its Guatemalan and Peruvian chapters, the project has relied on the cooperation of the Fundación de Antropología Forense de Guatemala (FAFG) and the Equipo Peruano de Antropología Forense (EPAF).

In elaborating of the guide, some key forensic documents have been taken into account, such as the *Minimum Forensic Standards for the Search for Disappeared Persons and the Recovery and Identification of Corpses*, prepared by Colombia, and documents written by FAFG, EPAF and the International Committee of the Red Cross (ICRC), as well as other international documents that reflect good practice. A draft of the guide was sent to ICJ, EPAF, and FAFG for their comments and review.

As far as the work methodology is concerned, in addition to reviewing the literature on this topic from the three countries mentioned above, international material has been consulted, in particular guidelines and protocols on forensic matters produced in other regions of the world. Furthermore, EAAF’s 36-year experience in this field, which includes the countries under analysis, has been invaluable to understand the processes and specificities of this region. In short, although this document focuses on these three countries, it adopts a global approach, mostly described in the “Minnesota Protocol”, which is applicable to any context.

It is also important to note that, beyond their similarities, the search for victims of enforced disappearance in the three countries has evolved along different paths. In some cases, it has been characterized by the strong presence of the state (as in Colombia and, to a lesser degree, Peru); in others, as in Guatemala, the state has been completely absent. At the same time, it should be underlined that search processes in the three countries have never been linear. In the case of Colombia, the search was carried out during domestic conflict, whereas in Guatemala and Peru this process started after violence was over (in 1992 and 2002, respectively).

The picture described above has had forensic consequences, which are reflected in the slight differences observed in terms of technical denominations and some aspects of the scientific process related to the search for, recovery and analysis of the bodies. This has become evident in the case of Colombia, where

forensic experts are public officials working for state organizations, whereas in Guatemala they belong to NGOs. In Peru, there are experts of both kinds.

Finally, with regard to the structure of the guide, the contents of the document have been organized following the logical order of the different steps required for the search for, recovery, analysis and identification of remains, as well as for the communication of the outcome to the victims' relatives.

## Objective

The objective of this forensic guide is to provide a practical and simple tool for cases that involve the investigation, recovery and analysis of human skeletal remains for purposes of identification and determination of cause of death in contexts of human rights violations and violations of international humanitarian law.

These cases are very often dealt with by state institutions specialized in ordinary criminal cases or mass disasters, which leads to errors at different phases of the investigation. This guide is therefore intended to address complex cases in which the perpetrator is not an individual but state officials, parastatal forces or rebel groups. It is not designed to replace any existing manual on the subject prepared by institutions or any academic textbook on the matter, but to serve as a common action protocol for all organizations performing forensic tasks, both at the official and non-official levels, in Colombia, Peru and Guatemala. It is important to highlight that these three countries have a more than 20-year forensic tradition devoted to this type of cases, which means that much of what is stated in this document has become daily practice in their respective forensic areas.

This guide is intended to reach diverse target audiences including lawyers, judges, prosecutors, the police, and forensic teams, but also families of victims and their associations. As the audience is heterogeneous, plain language was used, free from any technicality or complex vocabulary. Furthermore, the Guide aims to identify the minimum elements of the investigation in each of its phases, without purporting to exhaust all the possibilities available. Thus, institutions implementing it will find it easier to reach consensus on working methodologies and the use of common forms, as well as to adapt it to each particular context.

As stated in the Introduction, this guide is based on the ***Minnesota Protocol on the Investigation of Potentially Unlawful Deaths (2016)***, but it is mainly devoted to forensic aspects and cases involving **skeletal remains** rather than fresh or decaying corpses.

This guide reflects 35 years of uninterrupted forensic practice in Latin America, involving complex cases, different judicial systems and an intermittent interaction with state agents responsible for conducting investigations, such as lawyers, judges, prosecutors, the police and forensic experts. In light of this background, it is important to note that the guide has taken into account the

perspective of the family members of those affected by violence, their constant fight for truth and justice, and the resourcefulness they have had to develop over time to interact with institutions that are reluctant to carry out a prompt, independent and effective investigation.

The participation of the victims' relatives in the investigation process has gained ground in the three countries, with differences according to their respective context. Therefore, it is also the purpose of this guide to spread knowledge and foster exchange between two sectors usually kept separate and at opposite poles: justice operators and victims' family members. However, the persistent work of human rights organizations has undoubtedly been the main engine to urge states to investigate and prosecute the perpetrators of crimes under investigation. This has been crystal clear in the three countries.

On many occasions, reference is made to the participation of the victims' relatives in these processes, without mentioning however what that participation means. As stated above, there have been many different modes of participation, but in our opinion, the victims' families and their organizations should sit at the table where the political decision as to the type of mechanism to be used for search purposes is taken.

While the tasks of recovering bodies or gathering antemortem (AM) data should not fall within the relatives' sphere of responsibility, they should however be informed about legal and technical procedures as well as be able to do consultations, have access to forensic reports, pose questions to the forensic experts involved, challenge them by resorting to their own forensic experts if they do not agree, and dispose of the bodies in a manner befitting their loved ones. To take the victims' family members merely as passive AM data givers is a frequent mistake.

## Rationale

One of the most evident and negative results of the violence that swept across Latin America in the last sixty years was the enforced disappearance and death of thousands of people. From Mexico up to Argentina and Chile, violence took very different forms—it was typically perpetrated by military dictatorships that seized power by overthrowing legitimately elected governments (Brazil, Uruguay, Chile, Argentina, Guatemala, among others), but also by civilian governments (as in Mexico, Colombia and Peru).

With the return of peace and democracy, the search for, recovery and analysis of bodies became key elements in the transition towards democratic rule. The relatives of victims of enforced disappearance and violence played a key role in making the new governments take action and investigate past events.

The Truth Commissions and the actions taken by the judiciaries were basic mechanisms implemented by the region for that purpose. In turn, the regional system of justice, under the Organization of American States (OAS), as well as

the Inter-American Commission on Human Rights and the Inter-American Court of Human Rights, with their investigations and rulings, played a fundamental role in the process.

On the forensic side, new mechanisms had to be adopted given the local situation. A lack of trust in public forensic experts in many countries combined with a lack of experience with skeletonized bodies gave rise to new forensic initiatives outside the scope of the state, namely EAAF, FAFG, EPAF, and others in Chile, Uruguay, Colombia and Mexico. With the passing of time, the forensic practice, which until then had remained unrelated to the wishes, needs and rights of the victims' relatives, started to incorporate a "social" component, thus conferring credibility and transparency to processes lacking these essential components in the past.

It is in this context that, in 1991, a group of legal and forensic experts gathered by the University of Minnesota prepared the "Minnesota Protocol" (*Manual on the Effective Prevention and Investigation of Extra-Legal, Arbitrary and Summary Executions* (1991)), which was published as a formal document by the United Nations. This protocol was updated in 2016 and describes the minimum standards required for investigations into cases such as the ones that were beginning to be investigated in the region.

In 2020, several decades after the events, investigations are still underway to find the victims of enforced disappearance and killings in different Latin American countries, particularly in Colombia, Peru and Guatemala. The experience gained and the achievements made have been important, as they have contributed to devising a work method that is applicable to similar contexts of violence in other parts of the world.

However, thousands of persons are yet to be found and it is imperative that those responsible for investigating and administering justice be equipped with **common** practical tools, such as the ones provided by this guide, in order to help them improve their investigations and their response to the victims' relatives.



## General Considerations

Forensic investigation into cases involving the recovery and analysis of human skeletal remains is a complex process in which several scientific disciplines take part and are expected to provide, each one from its own specificity, a joint conclusion concerning the identification of the remains and the cause of death.

Usually, the forensic team works under the coordination of a prosecutor or a judge, who is in charge of conducting the investigation and is ultimately responsible for the investigation and prosecution processes. However, a “humanitarian approach”, as opposed to the criminal investigation, or complementary to it, as is the case of Peru, has recently emerged. The new approach focuses on the search, not so much for the purpose of prosecuting the individual or group of people who perpetrated the crime, but for the purpose of finding the body of the missing or murdered person in order to return it to their relatives. In other words, emphasis is not on the criminal investigation. The ICRC has been the institution more strongly committed to this approach, which is known as “humanitarian forensic action.” This approach has gained strength in countries where there is no consensus to conduct a criminal prosecution against crime perpetrators (Cyprus, the Caucasus) or where transitional justice models have been adopted, as in the case of Colombia in 2016.

The humanitarian approach has its advocates and detractors. The former prioritize the possibility of finding the victims’ bodies and returning them to their families, given what this means to each family and to society at large. This view reflects the fact that the reconciliation and peace component is crucial. To its detractors, this approach is understood as a relinquishing of justice and a guarantee that violence and impunity will reign again. There are few examples of a “purely” humanitarian approach in the world, Cyprus and Georgia (in the Caucasus) being two of them. In Latin America, only Colombia and recently Peru have adopted some humanitarian criteria, which coexist with other ones drawn from the transitional justice approach.

In any event, though, the task from the forensic standpoint is similar, regardless of the context of the investigation. The usual procedures for other types of cases, such as the maintenance of the chain of custody when handling evidence or the appointment of experts by the judicial authority, should be followed.

This complex process is made up of phases that, though carried out by specialized professionals, sometimes from different institutions, should be standardized and integrated to ensure that conclusions can be drawn from the case under study. Lack of coordination between the various phases, poor communication among the persons involved, and failure to integrate results will hinder the resolution of any case.

## Scientific Specialties: Human Resources

As mentioned above, this kind of investigation poses challenges that need to be addressed by resorting to a multidisciplinary approach. The main specialties required in the process, all of them within the forensic science framework, are the following: *archaeology* (in charge of the search for and recovery of bone remains as well as any associated evidence in the field), *physical anthropology* (responsible for analyzing the skeletons for identification purposes), *social anthropology* (to interview the victims' relatives, understanding the context and their religious and cultural practices), *medicine (pathology)* (to determine the cause of death), *odontology* (for the analysis of the victims' teeth), *radiology* (responsible for analyzing the remains' imaging), *genetics* (in order to recover genetic profiles from skeletons) and *criminalistics* (in charge of analyzing, documenting and protecting the evidence associated to the bodies). Depending on the case, other specialties may be summoned to participate as well, such as geology, entomology and chemistry. Furthermore, ballistics and other traditional branches of forensic science may have a fundamental role to play in relation to other elements found in association with the remains, as more specific analyses may be required.

At the initial investigation phase, which involves the context in which the events took place and finding an answer to *who, when, how, where, what and why*, the resources to be used and the sources of information to be consulted are, potentially, almost unlimited: from official documents to phone calls and social media.

Finally, it should not be forgotten that in this type of investigation, particularly when dealing with human rights violations and infringements of international humanitarian law, victims' relatives have an important part to play not only as providers of basic information on their loved ones, but also as key actors in the process, founded in their right to the truth. In this regard, the different areas of psychology are crucial throughout the investigation process.

## Infrastructure

The multidisciplinary approach already mentioned should be accompanied by adequate infrastructure to facilitate the development of the investigation at its different phases. This infrastructure ranges from the field material required for prospecting tasks and archaeological excavations to the building of different laboratories where the recovered bodies will have to be preserved, prepared and analyzed.

At the same time, it is essential that all the tasks described should be performed under Standard Operating Procedures (SOPs) that will serve as a roadmap throughout the process. SOPs are documents that describe the interrelation between the different departments, standardizing procedures and avoiding vagueness and impromptu decisions that may cause problems or inefficiencies in the work to be done. They are a sort of "checklist" that all the team members should follow so as to avoid individual or extemporaneous decision-making.

## Work Phases

As in any ordinary criminal investigation, the process designed to recover and analyze skeletal remains involves different phases. Even though the phases are common to any criminal investigation, they are handled by resorting to the humanitarian approach. This has a deeper impact on the work methodology than on concluding the search. These steps are unavoidable if the fate of the victim of enforced disappearance is to be determined.

Here it is important to introduce the concept of Chain of Custody (CoC), which is a process that enables all the phases involved to be fully recreated and tracked, i.e. who controlled and had custody over of the evidence from the time of its collection to date. In other words, all the material evidence delivered to/recovered by the investigator throughout the phases described below should be set down in a legal document known as the CoC, which records what was recovered, by whom (and their institution), and who received it for its custody and analysis.

Below are the work phases listed in order:

**1. Preliminary investigation:** it consists in recovering three types of information:

- a). All the information available (written, oral, photographs, videos, mobile phones, social media) on the case being investigated, from the time of the disappearance to the final disposal of the body (who, when, how, where, what and why).
- b). Biological information or any other associated data on the person being searched for. This is commonly known as AM information and it includes the taking of biological samples for genetic analysis, and the description of the victim's clothes and personal items.
- c). Information related to the family group, through a genealogical tree or genogram, which will represent the whole family—with full names—indicating who in the group is/are missing, who are the donors of genetic reference samples and who are dead or are not willing to donate samples.

To collect the last two types of information, it is vital to interview several family members of the victim of enforced disappearance, at different times and places. This will be further developed below.

**2. Archaeological phase/crime scene/findings:** This phase usually involves two stages:

- a). *Prior assessment*—the stage in which all the information on the area where the remains are likely to be found is collected (maps of the region, aerial/satellite photographs, etc.) and the specific area in question is visited in order to locate the grave, examine the features of the zone, talk with the local people and authorities, assess logistic, security and communication issues, etc.

b). *Archaeological excavation* —after the initial stage, the strategy to address the case is defined, and this involves isolating and protecting the area, documenting the findings, if any, excavating the graves, and recovering the bodies together with any associated evidence. The chain of custody of all the evidence recovered starts at this point.

**3. Laboratory phase:** At this phase, the remains and evidence recovered are taken to the laboratory to be prepared and analyzed by a multidisciplinary team for identification purposes and to determine the cause of death.

**4. The identification process: the integrated report:** At this fourth phase, all the forensic specialists involved in the recovery and analysis of remains should gather their results in a single and integrated report to be submitted to the prosecutor or judge in charge of conducting the investigation (if it is a criminal case). This means combining the non-genetic reports with the genetic results obtained in order to produce the so-called Integrated Experts Report.

**5. Communicating the results to the family members/community:** In ordinary criminal cases, this final phase is the sole responsibility of the prosecutor, but in cases of human rights violations and breaches of international humanitarian law, this is usually a broader and more complex process. The role of forensic experts is fundamental, as they are the ones to communicate with family members and explain their findings and conclusions in clear and plain language.

Finally, in Latin America, it is very frequent for investigations to include a psychosocial support component to accompany both families and investigators throughout the process.

These five phases above described should be closely related to one another, since their seamless integration will contribute to a better investigation.

Where investigations have already been conducted, as in the cases handled by human rights advocacy organizations or Truth Commissions, some of the initial phases (basically, phases 1 and 2) are underway or complete. In such cases, therefore, there will be no need to start from the very beginning, but one can resume such investigations, confirm the quality of the information gathered and make headway more quickly.

In every case, it is vital for all investigators to gain the most comprehensive understanding of the case possible, especially in phases 1, 2 and 3. Below, more details are given on the five phases.

## Preliminary Investigation Phase

Carrying out a preliminary investigation is fundamental for several reasons:

- More often than not this is the first contact with the missing person's family/community and/or with the site where the grave is located.
- It will contribute to forge initial bonds of trust and respect with the victim's relatives/community.
- It is an opportunity to explain and discuss the goal, scope, limitations, expectations, doubts and other issues related to the investigation.
- Information deemed critical for the investigation will be gathered.
- It will help to construct working hypotheses on the location of remains; get to know the number of victims and their names, the potential names of the killers and their affiliation; and design an excavation plan.
- It will help organize the information into databases and analyze it together, as a unit.

As mentioned above, this phase involves gathering information to reconstruct whatever happened to the victim and what they were like biologically.

“Whatever happened to the victim” very often implies getting to know and reconstruct the path followed by the victim from the time before the kidnapping/killing to the disposal of the remains.

Some of the tasks to be performed are carried out outside the ordinary boundaries of the area of investigation, for example, when it is necessary to consult archives located in other cities or interview witnesses not living in the area.

### **Working with Written Sources**

In cases such as the ones we are discussing, where either the state or a specific civil society group is responsible for the crimes committed, it is necessary to survey a wide range of written sources, among which the most relevant ones are the following:

- The report filed by the victim's family members/community on the enforced disappearance with an official body (police, army, mayor's office, ombudsperson, prosecutor's office, or other) or with a local or international human rights organization.
- Investigations initiated by any of the above organizations on the basis of the disappearance report filed.
- Any administrative document on the event produced by the state: authorization to lift and move the body, autopsy reports, photographs, fingerprints of the bodies, morgue books, cemetery books.
- Police or military files on the events.
- Files produced by the judiciary, prosecutor's office, military courts.
- Files produced by the ombudsperson's office or other agency.
- Reports on the case or cases in the region concerned drafted by a Truth Commission or similar body.

- Reports made by local or international human rights organizations.
- Reports made by countries such as the United States, which usually collect data during periods of violence.
- Press releases.
- Academic papers.

In recent years, the variety of potential sources of information has substantially increased, with the development of cell phones, CCTV cameras and social media, making it possible to track and determine the communication path related with the facts under investigation. However, it should be borne in mind that these new tools, as helpful as they might be for search purposes, can also be subject to data manipulation. Consequently, forensic investigators should check for data authenticity against any criminal action.

It is important to understand that, although the efforts made are directed towards identifying the bodies of victims, conflicts of this kind usually involve a given regional and political dynamics whereby an individual case falls within a specific systematic strategy. Therefore, associating or relating cases, such as the kidnapping of different people throughout a given period in a given region, is fundamental. Each case should be understood and viewed from a comprehensive standpoint and, if possible, should encourage the search for common patterns.

In this regard, it is essential for investigators to be very well acquainted with the characteristics and dynamics of each conflict, i.e. the groups in dispute, the geographic regions affected, the actions taken by the state and rebel groups, the changes taking place over time and space, and the usual practices to dispose of the bodies, among other aspects.

### **Working with Oral Sources**

Oral sources are people who can provide information on the victim and/or the event that led to the victim's enforced disappearance. Such people may be primary witnesses (either because they participated in or watched the events) or secondary witnesses (they overheard, were told about the events or read about them).

This group of people is usually made up of:

- the victim's family members
- friends
- neighbours
- fellow militants
- fellow detainees
- criminal suspects

All may be in a position to supply information about the events, but also about what the victim looked like from the biological point of view. Even though direct family members are better informed to provide AM data, friends, neighbours and witnesses who were acquainted with the victim should not be discarded, as they can also provide relevant data.

In any case, there are basic principles establishing how the investigator should approach the person to be interviewed. Therefore, some of the basic principles that should be observed are the following:

- It should be considered that in countries such as Guatemala and Peru, and to a lesser extent Colombia, violence was particularly targeted against the indigenous population. This imposes investigators the need to get to know the cultural and religious specificities of the local people and their relationship with Western law and science.
- Learn about the context, the region and the impact of the conflict on the area.
- Plan beforehand what you will ask about traumatic and sensitive matters.
- Explain as clearly as possible the objective, scope, institutions involved, time frames and expectations of the investigation.
- Explain how the information to be supplied will be protected and where it will be kept.
- Get an “informed consent”<sup>1</sup> for what is regarded as private data, such as biological samples for genetic analysis.
- Resort to the “life story”<sup>2</sup> technique, used by social anthropologists, which is usually one of the most adequate ways of approaching a victim’s relatives.
- Respect the interviewee’s cultural and religious patterns, which involves conducting the interview at the right time and place.
- Allocate enough time for the interview.
- Resort to interpreters, if necessary.
- Ensure that psychosocial support can be granted, if necessary.
- Design specific forms, agreed upon by consensus among all the participating institutions, to conduct the interviews intended to either reconstruct the “narrative” of the case or collect AM data.
- During the interviews, bear in mind that people often speak about matters not strictly related to the case, and that it is necessary to respect such processes.
- When asking about AM data, use clear and simple language, suitable for the context.
- Remember that the interviewee’s concepts of “health” and “illness” may differ from the ones held by the interviewer.
- Bear in mind that on many occasions a single interview might not be enough, and that a family member or witness may need time to find out some of the data requested.

### Collecting Antemortem (AM) Data

Traditionally, AM data comprise all biological information about the victim, such as sex, age, stature, dental characteristics, fractures, pathologies that usually leave a mark on bones, etc. It is relevant to remember that we will not be dealing with fresh corpses with fingerprints or identifiable faces, but with skeletons.

Today, all information related with the victim’s clothing and personal effects as well as with the context of the case is regarded as AM data. There are “closed”-cases<sup>3</sup>, for example a plane crash, where there is a strict list of victims from where we can start working toward their identification. In such cases, we know

### NOTES

1. An “informed consent” is a document intended to explain a victim’s family member the purposes for which a biological sample will be taken from them so that it is signed as a form of understanding and consent.
2. “Life story” is a common methodological procedure in social anthropology based on interviews that create an atmosphere of trust and transparency to gather information about the whole family group.
3. “Open” or “closed” cases are categories based on the availability of accurate information about the victims’ names. An open case is that for which there is no accurate information, as in an earthquake, whereas an example of a closed case is a plane crash, as there is a list of passengers.

that nobody else apart from those in the list will be found, whereas in “open” cases, where the event involved a larger group, it is hardly impossible to rely beforehand on a complete list of victims to start with. Therefore, gathering as much AM data as possible is very important. For example, if a victim’s body was subjected to an autopsy by a medical examiner before being buried as a John/Jane Doe, the analysis of the injuries found in the corpse after its exhumation may be confronted with those described in the original autopsy report and incorporated as an additional element in the identification process.

Therefore, the collection of this kind of data should be thorough, extended to various members of the family and on different occasions.

### **Collecting Biological Samples for Genetic Testing**

Taking biological samples (saliva, blood, hair) from the victims’ biological family members is an increasingly common procedure in this kind of investigations.

As traditional identification techniques cannot be applied either partially or completely because of the condition of the corpses (usually skeletonized and with no fingerprints) or the absence of dental records for comparison purposes, genetics has become crucial in identification processes (see The Laboratory Phase section).

On the other hand, given the special characteristics of these samples, which are not orally supplied by relatives but are biological samples taken from their bodies, it is important to consider some legal, ethical and scientific aspects before undertaking this part of the process. The biological samples collected are usually stored and kept in genetic databanks. Where such banks should be located, who should manage and watch them, who should have access to them and other similar issues are to be defined by agreements by relevant state agencies as well as by the civil society organizations participating in the investigations, such as family members and human rights advocacy associations. All these procedures should be clearly specified and explained before taking the samples.

The most significant issues to be taken into account by the investigator or the person who will take the sample include:

- Be adequately trained and very well acquainted with the forms to be used, the material required and the basic aseptic procedures.
- Explain the victim’s relative being sampled that this procedure is no guarantee that their loved one will be found and identified —it is only a possibility.
- Explain that a corpse is identified by resorting to different techniques, genetics being only one of them, and by analyzing all kinds of information.
- Specify where you will keep the sample, who will safeguard it, for how long and that it can be removed from the bank of biological samples at any time, upon request by the family member.



- Describe what the informed consent is and explain that the sample will only be used for identification purposes.

It is important to highlight that the collection of AM data is a dynamic process that requires not only the necessary time, but also a careful timing. Assessing and consolidating all the information gathered is a fundamental step in the identification process.

## The Archaeological Phase

The archeological or field work phase involves the exhumation of the body and associated evidence by the forensic archaeologist jointly with a multidisciplinary team. Prior to this, it is necessary to follow a series of steps to locate the place where the remains are. Therefore, this phase consists of two stages: a) the search for the remains, and b) the recovery of the remains.

### **Search for the Remains**

The search for bodies, which is the step prior to their recovery, often overlaps with the preliminary investigation, field visits, interviews with witnesses, etc.

Bodies may be found in different **types of sites**:

- At official or clandestine cemeteries.
- Buried in graves excavated ad hoc or in natural cavities, such as a well.
- On the surface, either because they were not buried or because they were removed from their burial site.
- In rivers, lakes, or oceans.

In the case of buried bodies, **graves may be classified into**:

- Individual graves (one person buried).
- Mass graves (more than one person buried).
- Primary graves (original, not modified graves).
- Secondary graves (graves that have been modified by alterations or disturbance).
- Synchronic graves (mass graves where all the bodies appear to have been deposited at the same burial event).
- Diachronic graves (mass graves where the bodies appear to have been buried at different burial events).
- Disturbed graves (as a result of natural processes).
- Altered graves (as a result of human action).

Bodies may be found in different **states of preservation**:

- With soft tissue in different condition (mummified, saponified, etc.).
- Skeletonized.
- A combination of both.

According to their **condition**, bodies may be found:

- Complete.
- Incomplete, including different sections.
- Commingled.
- Fragmented and commingled.
- Burnt.

There is no single way to search for remains, to learn about where they are deposited, but there are different methods that can be used to that end, namely:

- Interviews with witnesses who may indicate where the remains may be found (because they witnessed/participated in their disposal or were told about it by a third party).
- Aerial photographs of the area and region where remains may be found.
- Satellite photographs.
- Maps or sketches made by potential witnesses.
- Archaeological prospection: changes in the ground, vegetation, type of soil, fauna, etc., that may indicate the presence of a burial structure.
- Intrusive methods: surveys with shovels or machines under the control of an archaeologist.
- Non-intrusive methods: use of geophysical methods, such as the ground-penetrating radar, seismic or electrical resistivity, LIDAR, among others.

## NOTES

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UXO is the acronym for unexploded ordnance, which may include from a grenade to all the way up to large unexploded shells or bombs.

Once the site of disposal of the remains, such as a grave, is found, the following steps should be taken:

- Determine the level of danger if mines or UXO<sup>4</sup> are present.
- Establish whether the place is private property and, if so, obtain the relevant authorization to survey the area.
- Preserve and isolate the area.
- Establish the location with a GPS.
- Take photographs of the area.
- Assess whether the site in question is at the risk of being modified (by human action or natural phenomena).
- Establish safety and security mechanisms.
- Define a strategy with the members of the community where the remains are found: coordinate with them when the team will return to perform the exhumation, who the experts assigned to the task will be, etc.

At the same time, a series of less technical issues related to the logistics of the operation should be assessed:

- Technical equipment.
- Access to the area.
- Safety and security measures for the grave, the community, the relatives and the investigators.
- Communications.

- Tools to be used.
- Infrastructure, in case the excavation takes a long time.
- Accommodation.
- Meals.
- Health care.
- Relations with the community.
- Relations with the media.

In some contexts, this stage involves the creation of a **record of sites** where remains are found, which will then be used to produce a map for future interventions. The prosecutor or judge, assisted by forensic experts and the organizations involved, will decide the best time for each intervention, taking into account:

- The risk that the site may be disturbed or destroyed.
- The quality of the information (site location accuracy).
- The quality of the identity hypotheses regarding the bodies.
- Any link to other cases.

### Recovery of the Remains

Once the preliminary assessment and information gathering steps are completed, the field team must plan the operation for recovering the remains. For this purpose, it will take into account all the data collected, from the most technical to all the logistical aspects, and inform the prosecutor, judge or designated authority in charge of the case of the minimum conditions for moving on to the next step.

In the following field visit, the multidisciplinary team, led by the archaeologist, will apply the usual technical archaeological procedures for the excavation, adapted to the circumstances surrounding this type of cases. Special consideration must be given to the relationship with the relatives/community, logistics and safety. The team will endeavor to recover the skeletal remains as well as any associated evidence (projectiles, clothing, personal effects, vegetation, etc.).

The basic concepts to be handled in this phase are the following:

- **Site code:** how the site and the associated evidence will be coded.
- **Documentation** of findings through field protocols, sketches, planimetry, photographs and video footage.
- **Packaging** of the recovered material<sup>5</sup>.
- **Chain of custody:** a written procedure describing the transfer of evidence to the lab.
- **Transportation** of the evidence to the place where it will be examined.

According to international guidance (see ICRC documents in the References section), the families/communities of the victims of enforced disappearance and the community have:

### NOTES

5.

“Packaging of the recovered material” means that any object or fluid recovered in the field must be packaged according to its composition so as to adequately protect and preserve it. Different plastic and paper bags are used for this purpose.

- The right to be present during the exhumations, as long as the usual legal safety and security procedures are observed.
- The right to perform—before and after the exhumations—the cultural/religious rituals that they deem appropriate, provided they do not disturb the place where work is being conducted.
- The right to be informed of the work plan and preliminary findings, and that the identity and cause of death analyses will be performed later at the laboratories.

## The Laboratory Phase

The laboratory phase involves the analysis of the recovered remains and associated evidence by a multidisciplinary team with the aim of identifying the remains and establishing the cause of death.

### **Infrastructure**

The place where the remains are to be analyzed should have the following minimum infrastructure:

- Sufficient space to place the tables where the remains will be analyzed.
- Good lighting.
- Good ventilation.
- An area for the deposit and storage of remains and associated evidence.
- A cleaning area.
- A photography area.
- An area for taking samples for genetic analysis.
- Access to X-rays.
- An area for the analysis of the remains.
- An area for the analysis of clothing and associated evidence.
- An area for storing paper documents.
- Access to computer terminals and databases.
- A library.
- Security.
- A meeting area.
- It is strongly recommended that the laboratory be used exclusively for the analysis of skeletal remains.

In addition, the laboratory should have the following minimum materials:

- Calipers of different sizes.
- Hand lenses and microscopes.
- An osteometric board.
- Age estimation casts.
- Photographic cameras (memories and batteries).
- Different types of scales, arrows.
- An X-ray film viewer.
- Cleaning elements such as toothbrushes, buckets, etc.

- Computers, printers, scanners.
- Databases.
- A saw and elements used for taking bone samples for genetic testing.
- Different types of containers.
- A barcode printer.
- A first-aid kit.
- Communications.

At times, the remains may still have some soft tissue or corpse fauna<sup>6</sup> attached; therefore, it will be necessary to have a “wet” cleaning area complying with biosecurity conditions.

### Human Resources

The team in charge of the analyses should be made up, where possible, of:

- A forensic pathologist or physician<sup>7</sup> (to determine the cause of death).
- A forensic anthropologist (to lead the identification process in the case of bone remains).
- A forensic dentist (for the analysis of dentition).
- A forensic radiologist (to take images and analyze them).

In the analysis of samples, these professionals may be assisted by other experts, such as biologists specialized in forensic genetics.

### Laboratory Management

It is desirable that the laboratory be governed by clear **Standard Operating Procedures (SOPs)**<sup>8</sup>, following international scientific criteria. In this regard, the laboratory must document its:

- Policies.
- Systems.
- Programs.
- Procedures.
- Instructions.

All this aims to ensure the following:

- The quality of the services provided.
- The transparency of the process.
- Quality controls.
- Sustainability.
- Ongoing training.
- Communication.

### Sequence: From the Field to the Laboratory

Once the body and all associated evidence are recovered:

### NOTES

6.

“Corpse fauna” means insects that feed on the body after a person is dead. They normally include flies and beetles that lay their eggs, which, if correctly recovered, can be studied to determine the time-death interval.

7.

In this document, the terms “forensic pathologist” and “forensic physician” are used interchangeably.

8.

A Standard Operating Procedure (SOP) is a document describing, through a set of instructions or steps, the chronological or sequential succession of the operations that must be followed in some work routines.

- They should be correctly packaged and given the appropriate code. In the case of bones, the use of rigid boxes rather than body bags is recommended<sup>9</sup>.
- The box containing them should be sealed and signed by the designated field expert and the prosecuting authority present in the field.
- The chain of custody form should be filled in.
- The remains and associated evidence should be transported to the laboratory where the analyses will be conducted, guarded by the relevant security staff as determined by the prosecutor.
- No analysis should be conducted in the field.
- The family and community members present should be informed of where the remains and the evidence will be taken, and a means of communication with the authorities should be established.

### Arrival at the Laboratory

Upon reaching the laboratory, the material should go through the following steps:

- The remains and associated evidence should be delivered to the designated head of the laboratory.
- The chain of custody form should be delivered and signed by the person who delivers it and the person who receives it.
- Within a reasonable time established beforehand, the forensic archaeologist responsible for the field operation should deliver their report—or at least a preliminary version—to the head of the laboratory team, including photographs, maps, etc.
- The materials should be taken to the designated storage area.

All the material received at the laboratory should undergo the following **preparation** for its subsequent analysis:

- Creation of a lab identification code (similar to the field code).
- Taking of photographs of the material received before breaking any seal.
- Checking that the seals are intact.
- Opening of the boxes in the presence of the forensic team's leader.
- Placing of the bone remains and associated material (clothing, personal items, projectiles, etc.) on assigned tables.
- Selection of the pieces that must be x-rayed in case of apparent perimortem injuries.
- Where necessary, cleaning of the skeleton with brushes and/or water.
- Drying of the remains in the shade.
- Making an inventory of the remains.
- Anatomical arrangement of the skeleton.

Once the remains are prepared, the following determinations and estimations should be made:

- Determination of species (in the case of suspicious bones as a result of commingling, fragmentation, etc.).
- Determination of the minimum number of individuals (in situations similar to the above).

### NOTES

9.

The reason for this is that plastic bags produce moisture and, hence, fungi that affect the DNA of the bones. Furthermore, they do not avoid the crushing of bones and may lead to postmortem injuries.

- Sex determination.
- Ancestry estimation.
- Age estimation.
- Stature estimation.

Next, the interdisciplinary group should work on the following:

- Dental analysis.
- Analysis of pathologies, discrete traits, and anomalies.
- Trauma analysis.
- Distinction between taphonomic processes and perimortem wounds.

The methods used in laboratory determinations and estimations should be accepted as international standards by the scientific community. Guides such as *Standards for Data Collection from Human Skeletal Remains* (Buiscktra and Ubelaker 1994) and the protocols of the Scientific Working Group for Forensic Anthropology (SWGANTH) are useful for this purpose (see the References section).

When indicators and databases relying on local collections are used, they should be properly validated by peer-reviewed publications, such as *Journal of Forensic Sciences* and *Forensic Science International*.

### **Sampling for Genetic Testing**

If a decision to take samples for genetic testing is made for identification purposes (see The Identification Process Phase below), sampling should be conducted once all the analyses mentioned above have been performed, unless exceptional circumstances warrant otherwise.

Usually, if the condition of the skeleton so allows it, the samples should be taken from the diaphysis of the tibia or femur (a window), and/or healthy dental pieces should be used.

The following steps should be undertaken:

- Taking of a photograph of the bone that will be sampled or of the dentition, including case code and scale.
- Cutting of the sample under standard aseptic conditions.
- Taking of a photograph of the cut sample, including case code and scale.
- Packaging of the sample in a container with the appropriate code.

The process should be associated with a specific form, which will be delivered to the genetic laboratory where the testing will be performed.

### **Trauma Analysis**

It is the responsibility of the forensic pathologist to establish the cause of death, assisted by the forensic anthropologist, particularly in the reconstruction of injured bones and in the interpretation of bone defects, fracture patterns, etc. The joint analysis by both specialists enhances the accuracy of the interpretation of trauma.

## The Identification Process Phase

In this type of investigations, a major goal is to identify the body recovered, which is indeed a complex process that involves a multidisciplinary approach using all the information available.

**Identifying is comparing;** for this purpose, it is necessary to have all the information available about what the persons searched for were like when alive, not only biologically, but also regarding their context.

Therefore, the identification process should consider the following AM information:

- Sex.
- Age.
- Ancestry.
- Stature.
- Distinguishing traits in the body.
- Diseases or traumatic events that have left marks on the person's bones.
- Dental characteristics.
- Prostheses.
- Genetic profile of potential relatives.
- Clothing.
- Personal effects.
- Historical context information: circumstances of the disappearance/death, whether it is an open or closed case, burial type, relationship with other persons in the same grave.

This list includes from the specific physical characteristics of the victim of enforced disappearance to the genetic profile to the context of the case.

All this information gathered during the preliminary investigations should be **compared** to the postmortem information, i.e. the analysis of the remains and their associated evidence, such as clothing or personal effects.

While genetic analysis can play a fundamental role in any identification, its application and results should be viewed in a broader context, considering all the factors mentioned above (see the Glossary below for a definition of terms).

It should be borne in mind that, despite the extraordinary discriminatory power of genetic testing and its possibility of expressing its results in statistical terms, as a percentage of likelihood, there are also some limitations, namely:

- Degraded DNA in bone/tooth.
- Contaminated DNA.
- PCR inhibition.
- False positives and negatives.
- Incomplete reference samples: absence of close biological relatives of the missing person.



- Closed, endogamous groups in the community affected.
- Lack of knowledge of the context of death/disappearance.
- Lack of a priori and a posteriori information.
- Difficulties in the follow-up of genetic matches by making a comparison with all the non-genetic data available.
- Lack of an identification statistical value.

All these potential limitations make it necessary that the genetic results be considered in the general context of the case; for this purpose, a multidisciplinary and comprehensive analysis of all the information should be undertaken.

In this regard, it is important to create **identification commissions** where the forensic experts that make up the field and laboratory teams can discuss all the characteristics of the case. In this way, they can prepare an integrated forensic report in order to provide the prosecutor in charge of the investigation with a unique and unequivocal position on the identification achieved.

### **Determining the Cause of Death**

As explained above, the determination of the cause of death is the responsibility of the forensic pathologist within the laboratory team or of the physician who signs the death certificate. But, in cases involving skeletal remains, they should work in collaboration with the forensic anthropologist, who will assist them in the reconstruction of the bone remains fragmented in perimortem circumstances and in the analyses of the mechanism that caused the injuries.

Usually, when working with skeletal remains, only the events that have left marks on the bones will be observable, such as wounds caused by:

- Fire, explosives, etc.
- Blunt-force trauma.
- Sharp-force trauma.
- A combination of the two above.
- Ballistic trauma.

Sometimes it is possible to observe the healing process of a fracture. This is usually related to violence suffered by the individual before their death, but close enough to the time of death when there is no consolidated bone callus. The injuries that led to the death of the individual, such as the one described, should be analyzed to observe any **patterns** that may be useful for the prosecutor's investigation. Finally, the forensic report delivered to the authority—judge or prosecutor—should consolidate the results of the partial reports and arrive at a clearcut conclusion.

It is recommended not to rebury the remains that could not be identified at this stage, but to preserve them in a secured place in case more data for comparison purposes are gathered later on.

## The Final Phase: Communicating the Results to the Family/Community

Communicating the results —whether positive or negative— to the relatives of the victim, as well as to their communities of origin, is an extremely sensitive process in which the following should be taken into account:

- It is primarily the responsibility of the prosecutor or judge to communicate the results to the family. Even though this is the legal procedure followed in most countries of the world, there are occasions when the family members are informed in advance by the forensic experts. Certainly, this poses a challenge from a procedural and confidentiality viewpoint, which must be faced with caution.
- The participation of the forensic team is essential, as it can explain the main findings and answer any questions using plain, not technical, language.
- The information should be communicated in an environment appropriate to the needs of the family members, with psychosocial support where necessary, although this support should not be imposed.
- The family members have the right to see the remains if they wish, as well as to receive explanations from the forensic experts of the findings and conclusions.
- The family members should be informed of how their loved one was identified and what methods were used, and have access to the final report.
- Once the remains are identified, they should be delivered to the victim's family as fast as possible.

## Conclusions

As stated at the beginning of this guide, this document is not intended to be an exhaustive account of the process of searching for, recovering, and analyzing bone remains in contexts of human rights violations, but rather to serve as a preliminary document that brings together the best forensic practices implemented in three countries that have been pioneers in such process, as is the case of Guatemala, Colombia and Peru.

It is worth noting that this document not only describes the technical and scientific procedures followed, it is informed also by the daily experiences of forensic colleagues who have been working on the subject for years.

A distinctive approach of this document is its emphasis on the right of the victims' families to be considered in the different stages of the search process: their right to know about the findings in due time and manner, to be properly informed, and to be able to ask supplementary questions to the scientists and authorities about the results.

In general, much progress has been made in the entire Latin America regarding the appropriate investigation into events similar to the ones described in this document. The "Minnesota Protocol" is widely used by investigators at all levels. Unfortunately, however, we are also aware that extrajudicial executions and enforced disappearances continue to occur in several countries of the region, not exclusively for political reasons as in the past, but for other reasons as well, such as organized crime.

We therefore hope that all state and non-state institutions from any country involved in the process of search for, recovery and analysis of remains consult this guide and apply it in their work.

## Glossary

**A priori:** A component of the Bayesian analysis of probability that, when applied to the identification of persons, refers to the likelihood of the identity hypothesis of a body before performing the forensic analysis. It is estimated on the basis of the number of missing persons sharing time and place circumstances with the individual to be identified.

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**Adventitious match:** In direct matching, it is when the sample from the victim shares, by chance, the same DNA profile as a person other than the one from whom the sample was taken. In kinship analysis, it is when a victim sample is matched to a family group by chance and not because they are biologically related. It is indirectly defined as a false positive, as it is a coincidental match which can result in incorrect identifications. The bigger the databases in which the search is made, the greater the possibility of adventitious matches and false positives.

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**Age estimation casts:** Clay figures that reproduce different stages of the pubic symphysis and the fourth rib, from youth to advanced age.

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**Allele:** One of the different forms of a gene. While the genetic markers usually analyzed in human identification are located in non-coding regions, in forensic genetics, the term “allele” is commonly used to define this type of sequence variation in non-coding regions of DNA.

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**Alteration:** In the archaeological process, an alteration refers to anything that indicates a change or perturbation in a burial site. Regarding bones, the term refers to any evident damage to or modification of tissues.

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**Amelogenin:** A gene located on the sex chromosome pair (X and Y). In forensic genetics, it is analyzed to determine sex in any type of forensic sample.

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**Antemortem:** Before death. A term used in forensic anthropology to categorize the alterations in bone normality that present some type of bone reaction and are indicative of having occurred some days before death.

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**Antemortem data:** Data about a named individual while alive that can be used to compare with postmortem data collected from the body, usually for the purpose of identifying the body.

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**Autosomal markers:** Markers located on autosomal chromosomes.

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**Autopsy:** The examination of a dead body involving its external and internal examination and incorporating the results of special tests (including radiology). The internal examination involves, but is not limited to, examining the contents of the cranium, chest and abdomen. Further dissection may occur in particular circumstances.

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**Biological profile:** Characteristics of a living individual, some of which may be observable after death and allow a physical description of the individual; they include sex, age and stature.

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**Cause of death:** The underlying cause (the disease, condition or circumstance initiating the chain of events resulting in death), possibly proceeding through more immediate (or proximate) causes, concludes the logically linked statements that constitute the cause of death.

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**Cemetery:** A place designed for receiving and housing corpses. There are public, private and mixed cemeteries, as well as illegal ones.

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**Chain of custody (of an exhibit):** A process enabling the complete history of the custody of an exhibit to be tracked and recreated; that is, who has had care and control of the exhibit from the time it was first secured to the present.

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**Context:** The set of circumstances in which a situation or fact is considered.

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**Corpse decomposition:** The process of dissolution of the body after death due to internal and external causes. In the early hours and days after death, some of the changes can be mistaken for injuries (e.g. signs of putrefaction such as swelling and purplish discoloration of the face and body).

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**Corpse delivery:** A proceeding through which the judicial authority orders that the identified body be delivered to the family member or persons entitled to receive it in a ceremony that is performed taking into account the particular needs and conditions of the victims, with due respect for the cultural and religious traditions of the families.

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**Discontinuous family tree:** A family tree in which there is a gap between two generations. In a case in which the parents are missing, the grandparents and the grandchildren are an example of a discontinuous family tree, because the generation between them is missing.

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**Distinguishing bone characteristics:** Particular and unique traits that are present in any of the bone structures that make up an individual's skeleton and that help distinguish it from others. They are usually recorded as part of the set of antemortem alterations.

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**DNA:** A DNA molecule consists of two long chains of nucleotides coiled into a double helix. DNA contains the genetic information needed for the development and functioning of cells in all living organisms.

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**DNA or genetic profile:** In forensic genetics, it is an encrypted set of numbers reflecting the genetic make-up of an individual for the specific genetic markers analyzed. Each genetic marker analyzed can be expressed as two numbers (e.g. 8-10) in the case of heterozygosity or one number (e.g. 8) in the case of homozygosity.

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**DNA extraction method:** Any method used to purify DNA from a biological sample, such as blood, saliva, semen, hair, bone, used garments, etc.

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**DNA quantitation method:** Any method used to determine the quantity of DNA in a given biological sample.

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**Electropherogram:** A graphic representation of the results of genetic profiling or of DNA sequencing.

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**Evidence:** Conclusive proof in legal proceedings.

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**Exhume:** To remove a person or thing, especially a corpse, from the ground after it has been buried.

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**Expert:** A person with a high level of knowledge or skill relating to a science, technique, art or craft. They may belong to a governmental or non-governmental organization. Usually, they must be designated as an expert by a judicial authority (judge or prosecutor).

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**Family reference samples:** Biological samples (blood, saliva, remains, etc.) from the relatives of the disappeared.

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**Forensic science:** The application of the principles and practice of science to the needs of the law and the courts.

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**Genetic markers:** A DNA segment with a known physical location in the genome.

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**Genetic polymorphism:** A form or variation of a particular DNA sequence in a gene or DNA segment which can exist among the individuals of a population or species.

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**Geographic Information System (GIS):** An organized integration of hardware, software and geographical data designed to capture, store, manipulate, analyze, and display all types of georeferenced information for the purpose of solving complex planning and management problems.

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**Georeferencing:** A spatial positioning technique in which an entity is given a unique and well-defined geographic location in a system of specific coordinates and datum.

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**Human genome:** All the genetic information contained in human DNA.

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**Identity:** The set of characteristics that individualize a person.

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**Kinship index:** A term used to refer to the Likelihood Ratio (LR) in a biological kinship test.

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**Likelihood Ratio (LR):** A logical way of presenting the results of DNA analysis, as it takes into account two mutually exclusive hypotheses. For example, a) the remains sample belongs to a particular missing person or b) the remains sample does not belong to that missing person and therefore belongs to another person. The ratio is the quotient of these two opposing possibilities. In forensic genetics, the LR is used to compare the significance or strength of a DNA match.

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**Locus:** The position that a given gene or genetic marker occupies on a chromosome. Pl. loci.

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**Material exhibits and physical evidence:** Any object, instrument or means of knowledge leading to the discovery of truth that is perceived through the senses or by the use of forensic technology, the analysis of which provides the scientific or technical basis to guide the criminal investigation.

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**Microsatellites (or STRs):** Regions of DNA with adjacent short sequences repeated a certain number of times, which can vary from one individual to another. These repetitive stretches of short DNA sequences are like train wagons hitched in tandem, which is why they are called variable number tandem repeats. In forensic genetics, microsatellites or short tandem repeats (STRs) are the markers most commonly used in human identification.

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**Minimum number of individuals:** Forensic anthropological term used in relation to the assessment of commingled remains and referring to how many individuals, as a minimum, are represented in the commingled remains being examined.

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**Mitochondrial DNA:** Circular DNA found inside structures called mitochondria located in the cell's cytoplasm.

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**Mutation:** A change in a DNA sequence in the genome that can be passed on to offspring. In forensic genetics, mutations must be taken into account, because otherwise the interpretation of DNA data can lead to incorrect results.

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**Nuclear DNA:** The DNA found inside the cell's nucleus. Nuclear DNA is arranged and packaged on chromosomes; there are 22 pairs of autosomal chromosomes and one pair of sex chromosomes, making a total of 23 pairs.

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**Osteometric board:** A board used to measure the length of bones.

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**PCR inhibitors:** Any substance that inhibits DNA amplification by Polymerase Chain Reaction (PCR).

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**Pedigree probability:** Kinship analysis based on the probability that the genetic profiles of several people belong to the members of the same family.

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**Perimortem:** Around the time of death. In forensic anthropology, the term is used to categorize those alterations of normality that appear not to have been repaired and whose characteristics indicate that they occurred when the bone still retained its viscoelastic properties.

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**Polymerase Chain Reaction (PCR):** An enzymatic process in which a specific DNA sequence is replicated or copied thousands of times. PCR can be likened to a “molecular photocopier” of DNA sequences, producing thousands of identical copies of the target DNA sequence.

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**Postmortem:** After death. In forensic anthropology, the term is used to categorize bone alterations whose characteristics indicate that they occurred when the bone no longer retained its viscoelastic properties. It involves various natural or intentional (chemical, physical, biological) taphonomic factors.

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**Postmortem data:** Data obtained from the dead body to compare with data obtained about a named individual while alive (ante-mortem data), usually for the purposes of identifying the dead body.

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**Prospection:** An archaeological procedure aimed at exploring a particular area, in order to confirm or rule out the presence of a grave or site used for corpse disposal purposes.

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**Random match probability:** A value that measures the probability that an individual chosen at random from the general population will have the same genetic profile as a forensic sample.

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**Reassociation:** The act of bringing body segments from commingled remains belonging to different skeletons into association again. Reassociation is achieved once the osteological and genetic individualization process has been completed.

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**Single Nucleotide Polymorphism (SNP):** A variation in a DNA sequence that affects a single nucleotide base (C, G, A or T) of a sequence in the genome.

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**Spongy bone:** Unlike compact bone, this type of bone does not contain osteons; the interstitial lamellae are irregularly arranged forming a lattice of thin columns of bone called trabeculae. It is found in the epiphyses (or ends) of long bones, in vertebral bodies, the sternum, pelvis, kneecap, etc.

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**Taphonomy:** Any observable changes that occur in the body after the time of death. Such modifications are as varied as are the contexts and circumstances.

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**Wound:** A significant discontinuity in the surface of a structure, most often in the skin, e.g. incised wound, stab wound, gunshot wound, laceration. It does not include a bruise or an abrasion.

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**X-ray film viewer:** A device used in the laboratory for displaying X-ray films.

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ARGENTINE  
FORENSIC  
ANTHROPOLOGY  
TEAM



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